



Real-Time Water Quality Deployment Report

Northern Harvest Smolt Ltd.

July 18th, 2023 to March 13th, 2024



Government of Newfoundland & Labrador
Department of Environment and Climate Change
Water Resources Management Division

Introduction

- The Real-Time Water Quality (RTWQ) Monitoring Network near Stephenville, NL consists of three groundwater well monitoring stations funded by Northern Harvest Smolt Ltd. The program is a joint partnership between Northern Harvest and the Newfoundland & Labrador Department of Environment and Climate Change (ECC).
- Each of the three stations consists of groundwater water quality and quantity monitoring equipment (water level) which transmits data in near real-time every 2-3 hours.
- The well stations are known as: MW5/6; FMW10 and FMW12. They were installed in November 2019 by ECC staff and first deployed on November 6th, 2019. The instruments remain in the monitoring wells year-round unless removed temporarily for maintenance and calibration.
- These stations measure the following water parameters: temperature, pH, specific conductivity, total dissolved solids (TDS), oxidation-reduction potential (ORP) and water quantity (depth). Parameters are recorded on an hourly basis during the deployment period and are available in real-time online:
- NLGWMW5/6: https://www.ECC.gov.nl.ca/wrmd/ADRS/v6/Template_Station.asp?station=NLGWMW56
NLGWFMW10: https://www.ECC.gov.nl.ca/wrmd/ADRS/v6/Template_Station.asp?station=NLGWFMW10
NLGWFMW12: https://www.ECC.gov.nl.ca/wrmd/ADRS/v6/Template_Station.asp?station=NLGWFMW12
- MW5/6 – This 50mm well is one of the thirteen wells which make up the Northern Harvest near field monitoring well network within 500m of the water supply area. This is a relatively shallow well at 2.92 m.
- FMW10 - This 50mm well is one of the five wells which make up the Northern Harvest far-field monitoring network which is set up outside the 500m radius of the hatchery. This well is relatively deep at 22.54 m.
- FMW12 - This 152mm well is one of the thirteen wells which make up the Northern Harvest near-field monitoring well network which is within 500m of the water supply area. This well is relatively deep at 31.16 m.



Figure 1: Map of Northern Harvest Smolt Ltd. Real Time Water Monitoring Network

- The purpose of this network is to monitor, process, and distribute water quality/quantity data to Northern Harvest Smolt Ltd. and ECC for assessment and management of water resources, as well as to provide an early warning for any potential or emerging water issues, allowing mitigative measures to be implemented in a timely manner.
- ECC will provide Northern Harvest Smolt Ltd. with quarterly and annual deployment reports for 2023. Data is available in near real-time on the ECC’s website.
- Gaps in the water quality data are the result of transmission loss by the stations or the removal of inaccurate data due to ongoing station maintenance during that time period.



(a) MW5/6

(b) FMW10



(c) FMW12

Figure 2: Northern Harvest Real Time Monitoring Network: (a) MW5/6, (b) FMW10, (c) FMW12

Maintenance and Calibration

- To ensure accurate data collection of the real time groundwater monitoring network, maintenance and calibration of the water quality instrumentation is performed approximately every four months.
- Maintenance includes a thorough cleaning of each instrument and replacement of any small sensor parts that are damaged or unsuitable for reuse. Once the instrument is cleaned, ECC staff carefully calibrate each sensor attachment for pH, specific conductivity and ORP to ensure accurate data collection.

Quality Assurance and Quality Control

- As part of the Quality Assurance and Quality Control protocol (QA/QC), an assessment of the reliability of data recorded by an instrument is made at the beginning and end of each deployment period. The procedure is based on the approach used by the United States Geological Survey.
- During the maintenance phase, a volume equivalent to three well casings is purged from each well prior to re-installation and the collection of grab samples. This process flushes stagnant water from the wells and ensures that the water being observed is aquifer water.
- After full purging of the well, the sonde is deployed and initial field readings are recorded. A grab sample is also taken when possible to compare the values of pH and specific conductance against the deployed sonde's initial values.
- Three instruments are owned by Northern Harvest and will be installed in the wells on a rotating basis to ensure data accuracy.
- Deployment comparison rankings for the stations are summarized in Table 2.

Table 2: QA/QC comparison rankings for Northern Harvest Stations

Station	Date	Action	Instrument #	pH	Specific Conductivity
MW5/6	19-JUL-2023	Deployment	19D105282	Marginal	Fair
FMW10	19-JUL-2023	Deployment	19D105281	Fair	Excellent
FMW12	19-JUL-2023	Deployment	19E100387	Good	Fair

Data Interpretation

- The following graphs and discussion illustrate water quality and level related events from July 19th, 2023 to March 13th, 2024 at Northern Harvest Smolt real time water monitoring network.
- All data used in the preparation of the graphs and subsequent discussion below adhere to this stringent QA/QC protocol. Corrected data can be obtained upon request.

Water Temperature

- After the initial acclimatization period, water temperature ranged from 4.3°C to 14.50°C within the well network (Table 3).
- During the deployment, water temperature at FMW12 varied little while FMW10 rose until December, then began gradual decline. At MW5/6, water temperature increased until late September when it began decreasing which lasted for the remainder of the deployment (Figure 3).
- MW5/6 is a shallower well and could be influenced by the surface temperatures and climatic conditions, therefore more variability is possible in the data.

Table 3: Water Temperature (°C) Summary Statistics from the Well Network

	MW5/6	FMW10	FMW12
MIN.	4.34	6.97	6.84
MAX.	14.50	8.96	6.94
MEDIAN	9.66	8.64	6.87

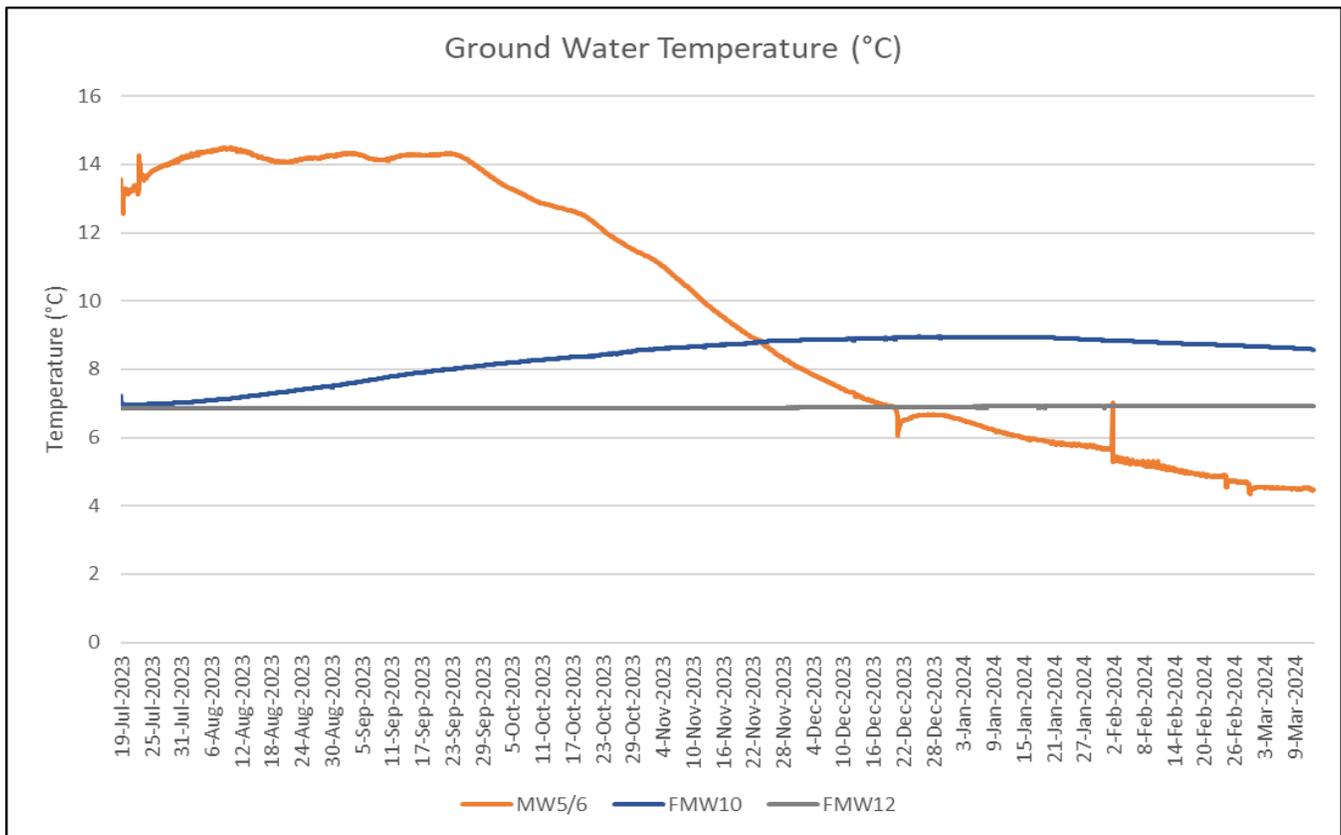


Figure 3: Ground Water Temperature (°C) – Northern Harvest Smolt Ltd. Network

Water Depth

- During the deployment, MW5/6 and FMW12 were relatively stable while FMW10 showed an increasing trend (Table 4). Slight variations in level were noticeable concurrently at all wells at the same time (Figure 4).

Table 4: Water Depth (MASL) Summary Statistics from the Well Network

	MW5/6	FMW10	FMW12
MIN.	1.81	6.52	6.04
MAX.	2.53	8.07	6.89
RANGE	0.72	1.55	0.85
MEDIAN	2.1	7.16	6.49

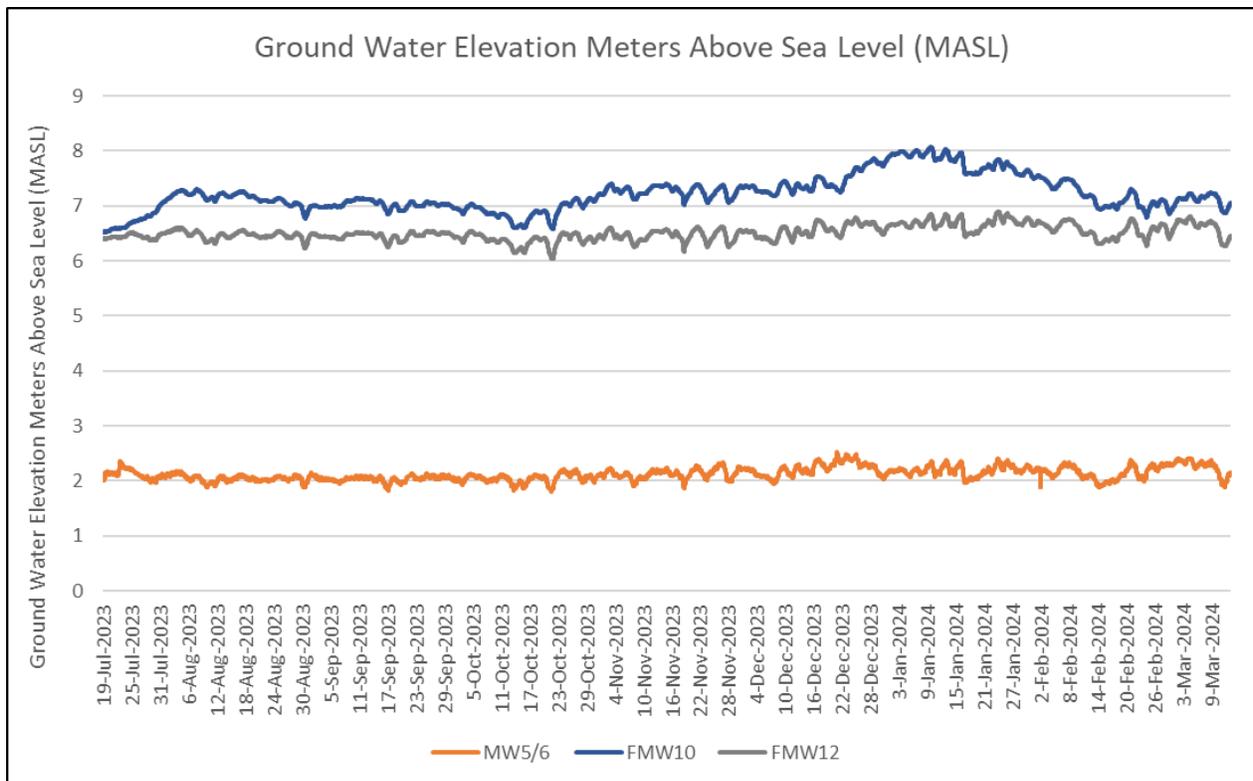


Figure 4: Ground Water Elevation (masl) – Northern Harvest Smolt Ltd. Network

pH

- After the initial acclimatization period, pH ranged from 5.79 to 8.19 pH units within the well network (Table 5).
- FMW10 & FMW12 were slightly basic, while MW5/6 has a lower pH than the other wells and is slightly acidic. All three stations were relatively stable with little variation throughout this deployment (Figure 5).

Table 5: pH (pH units) Summary Statistics from the Well Network

	MW5/6	FMW10	FMW12
MIN.	5.79	7.17	7.71
MAX.	6.43	7.75	8.19
MEDIAN	6.11	7.57	8.10

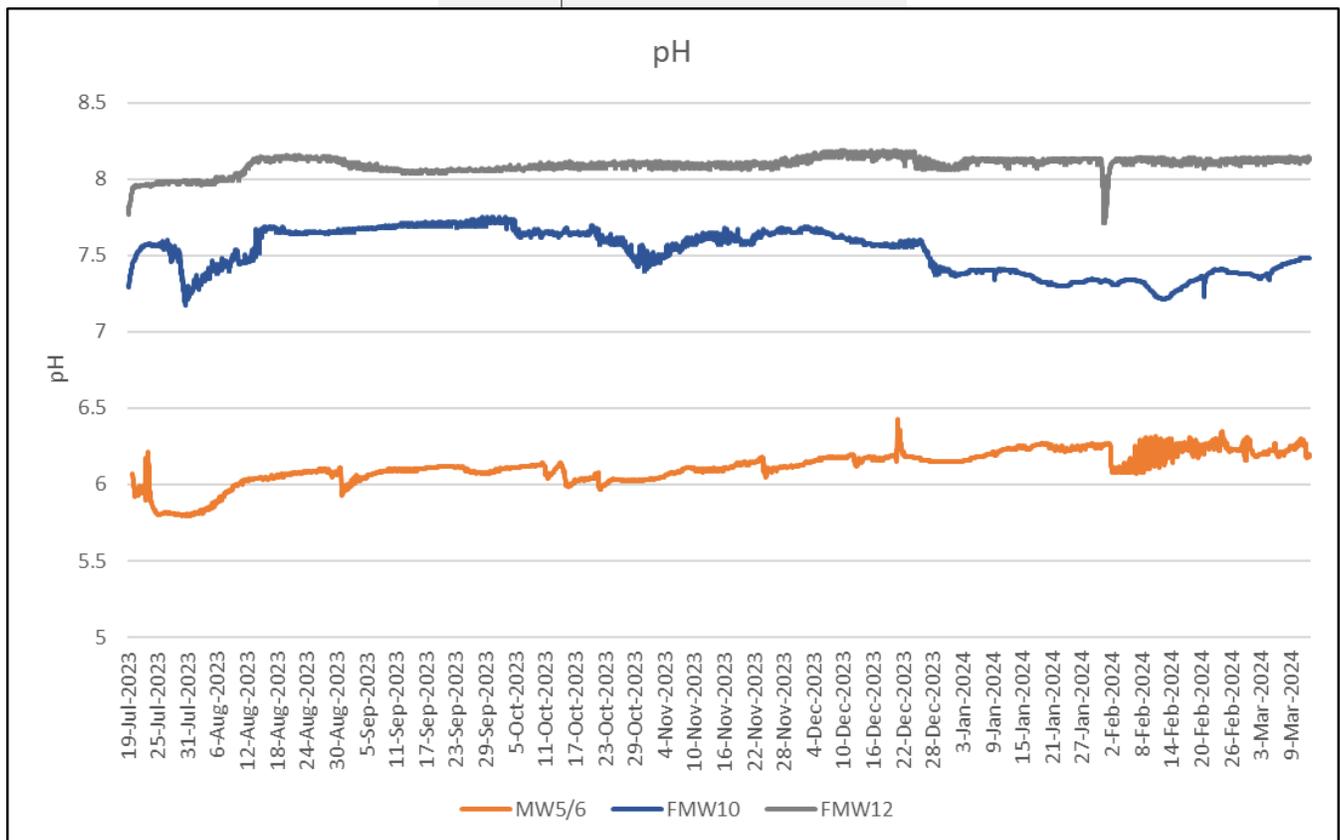


Figure 5: pH – Northern Harvest Smolt Ltd. Network

Specific Conductance and TDS

- After the initial acclimatization period, specific conductance ranged from 60.7 $\mu\text{S}/\text{cm}$ to 697.21 $\mu\text{S}/\text{cm}$ within the well network (Table 6).
- During the deployment, FMW12 displays little variation, FMW10 increases, and MW5/6 displays numerous fluctuations (Figure 6).
- Fluctuations at MW5/6 could also be due to the well being shallower and potentially influenced by climate changes around the well head.

Table 6: Specific Conductance ($\mu\text{S}/\text{cm}$) & TDS (g/L) Summary Statistics from the Well Network

	MW5/6	FMW10	FMW12		MW5/6	FMW10	FMW12
	SPECIFIC CONDUCTANCE			TOTAL DISSOLVED SOLIDS			
MIN.	60.7	376.41	327.63	MIN.	0.04	0.24	0.21
MAX.	211.84	697.21	341.90	MAX.	0.14	0.45	0.22
MEDIAN	118.68	420.61	339.69	MEDIAN	0.08	0.27	0.22

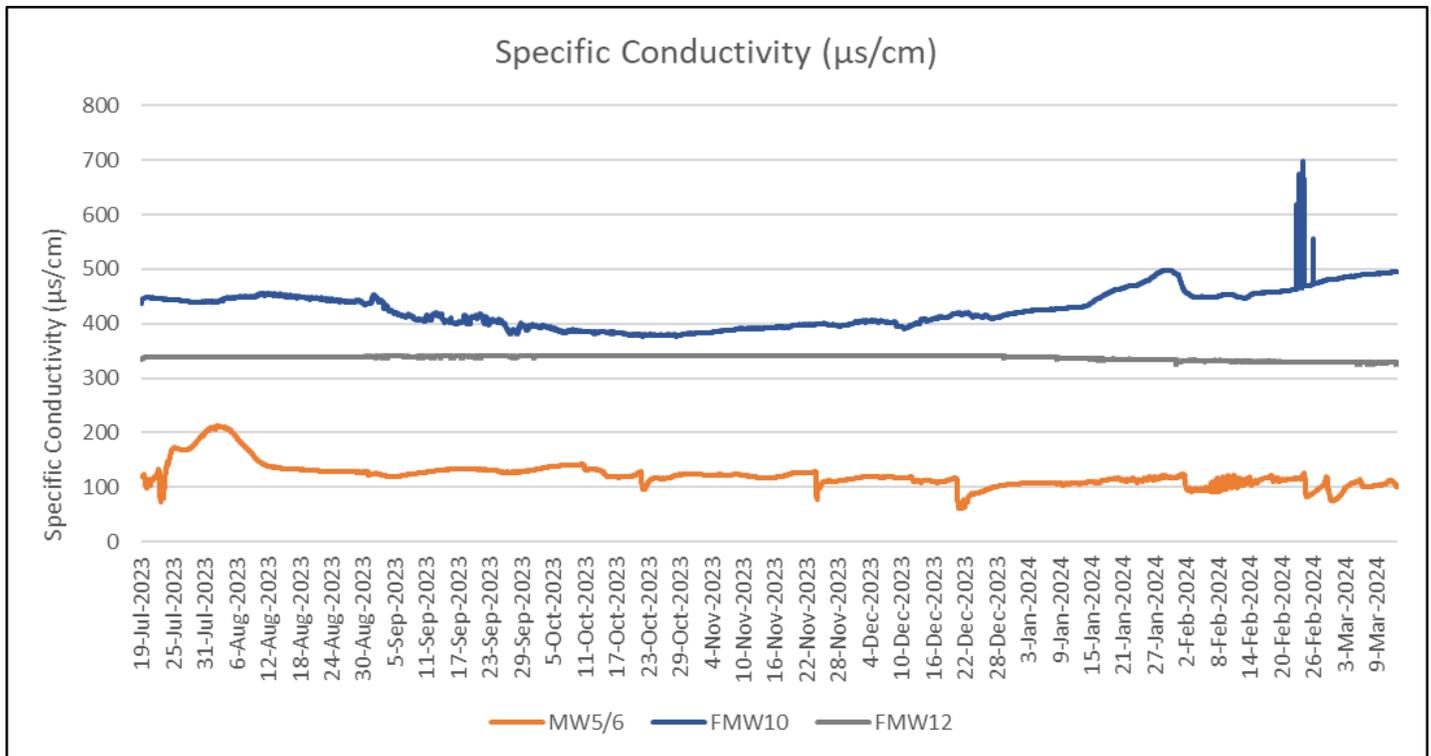


Figure 6: Specific Conductivity – Northern Harvest Smolt Ltd. Network

- After the initial acclimatization period, total dissolved solids (TDS) ranged from 0.04 mg/L to 0.45 mg/L within the well network (Table 6).
- TDS varied minimally throughout the network, with FMW12 displaying minimal change over the deployment (Figure 7).

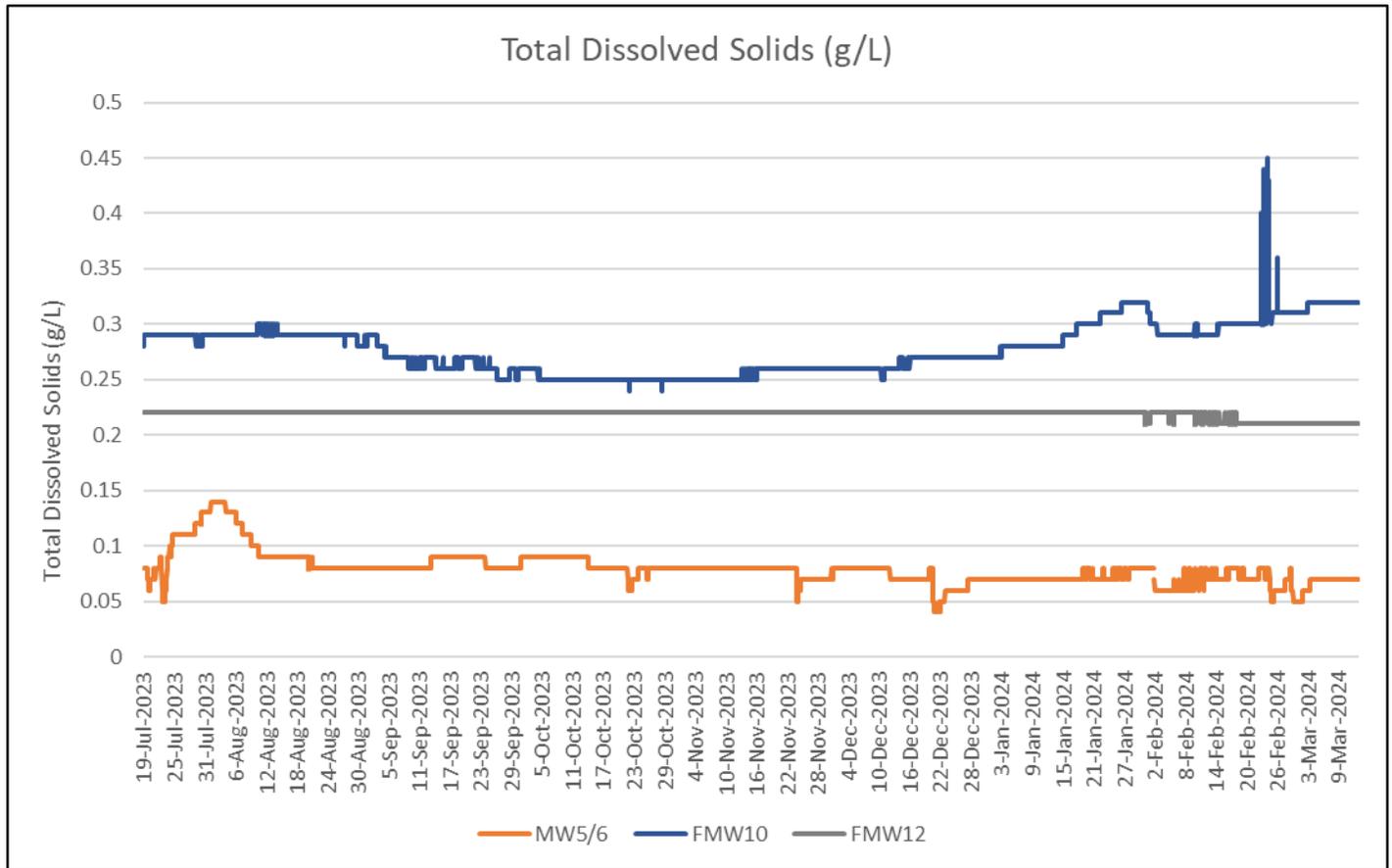


Figure 7: Total Dissolved Solids – Northern Harvest Smolt Ltd. Network

Oxidation – Reduction Potential (ORP)

- After the initial acclimatization period, oxidation-reduction potential (ORP) ranged from -484.4 mV to 413.55 mV within the well network (Table 7).
- Over the duration of this deployment, MW5/6 and FMW10 were both oxidative and reductive, while FMW12 was solely oxidative with MW5/6 showing the greatest variation within the network (Figure 8).

Table 7: Oxidation-Reduction Potential (ORP) Summary Statistics from the Well Network

	MW5/6	FMW10	FMW12
MIN.	-219.06	-484.4	113.05
MAX.	396.59	398.98	413.55
MEDIAN	48.63	349.46	376.22

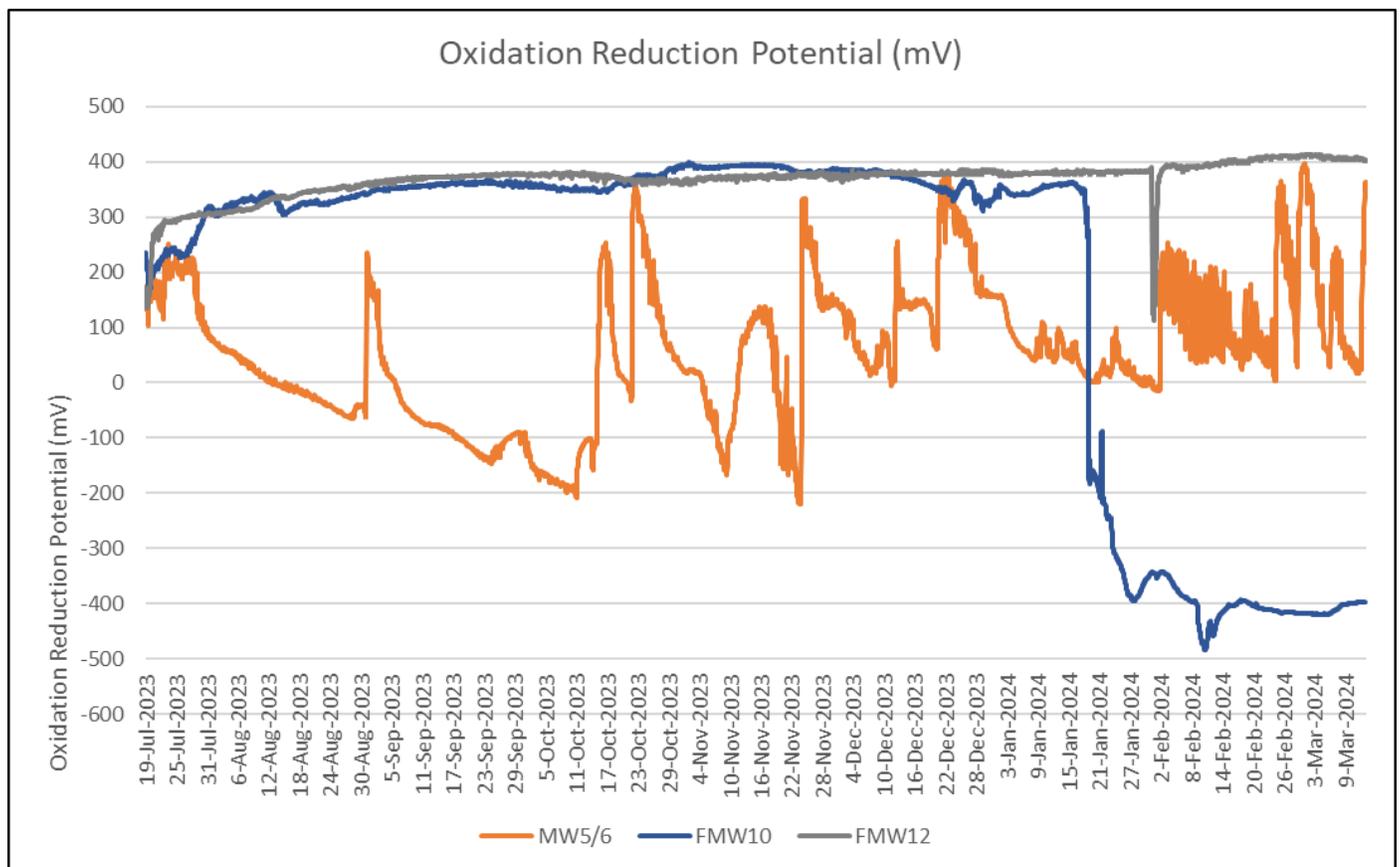


Figure 8: Oxidation-Reduction Potential (ORP) – Northern Harvest Smolt Ltd. Network

Conclusions

- The Real Time Water Quality and Quantity Monitoring Network at Northern Harvest Smolt Ltd was established on November 6, 2019 when instruments were initially deployed at each of the three wells in the network: MW5/6, FMW10 and FMW12.
- During this second deployment of 2023, data was monitored closely to determine if the instruments were accurately placed in the well casings and if there were other issues such as sensor errors.
- QAQC rankings ranged from Excellent to Marginal within the well network.
- Water temperature at FMW10 and FMW12 were stable, while temperatures at MW5/6 were relatively stable until Fall when they steadily decreased, potentially due to the well being shallow and influenced by climatic changes.
- Water depth was relatively stable at MW5/6 and FMW12, while FMW10 showed a slight increasing trend.
- pH at FMW10 and FMW12 was slightly basic while MW5/6 was slightly acidic.
- Specific conductivity at FMW12 displays little variation, FMW10 increased, and MW5/6 displays daily fluctuations while decreasing slightly over the deployment.
- ORP at FMW12 was oxidative, while FMW10 and MW5/6 were both oxidative and reductive with MW5/6 showing the greatest variation.
- For this deployment, the instruments performed well with few issues.

Path Forward

- Staff will continue to monitor the data daily for issues.
- If necessary, deployment techniques will be evaluated and modified, ensuring secure and suitable conditions for RTWQ monitoring.
- ECC will continue to work on its Automatic Data Retrieval System (ADRS), to incorporate new capabilities in data management and data display.
- Open communication lines will continue to be maintained between ECC and Northern Harvest Smolt Ltd in order to respond to emerging issues on a proactive basis. Northern Harvest Smolt Ltd will receive quarterly deployment reports and an annual report, summarizing the events of the deployment season.

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Appendix 1: Air Temperature and Precipitation at Stephenville, NL

